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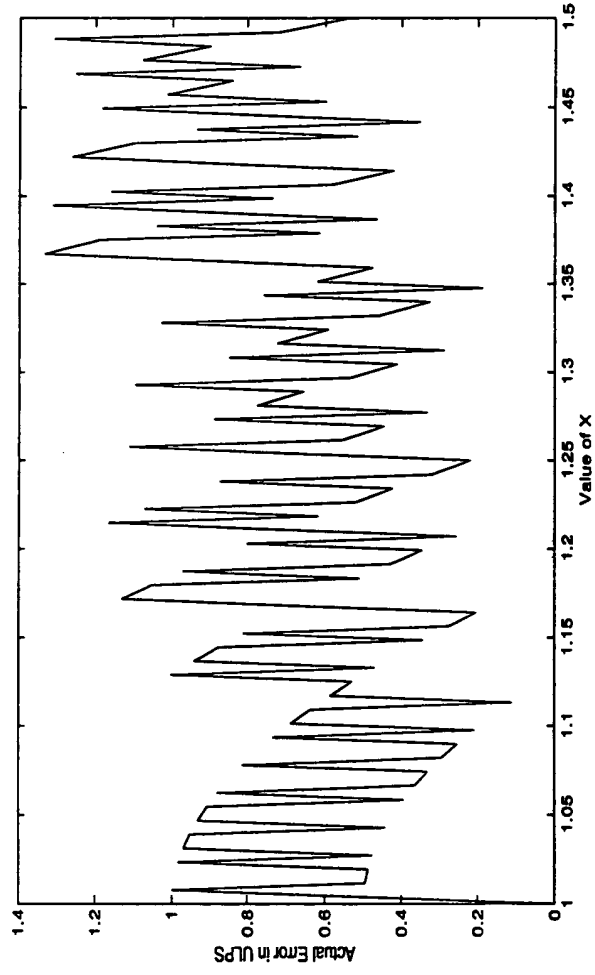


Fig. 1

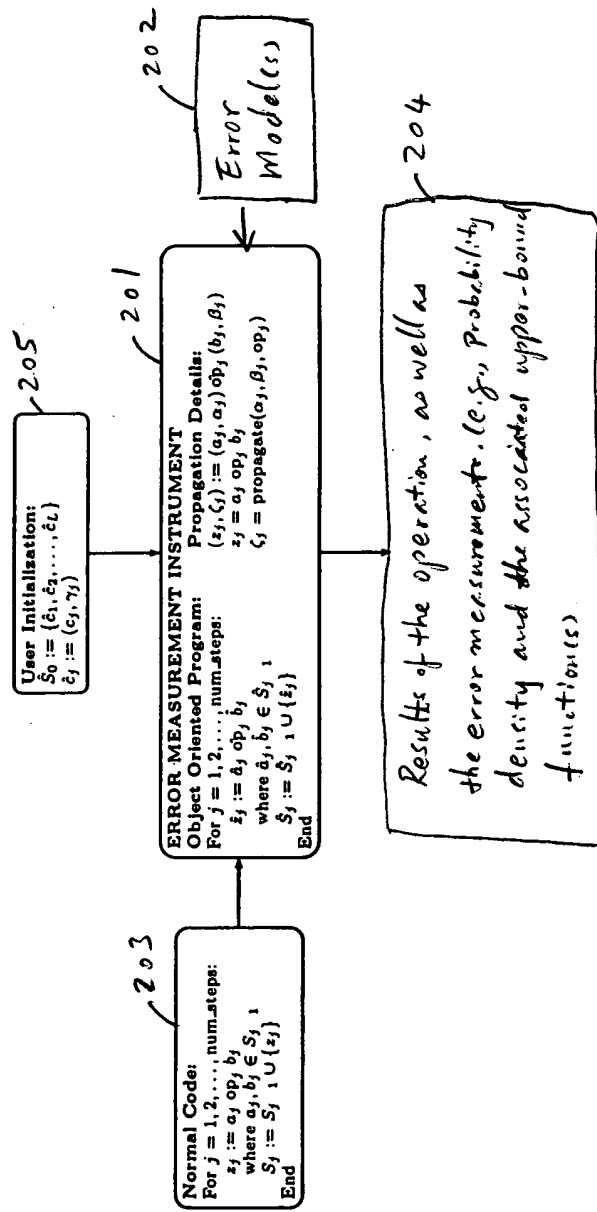


Fig. 2

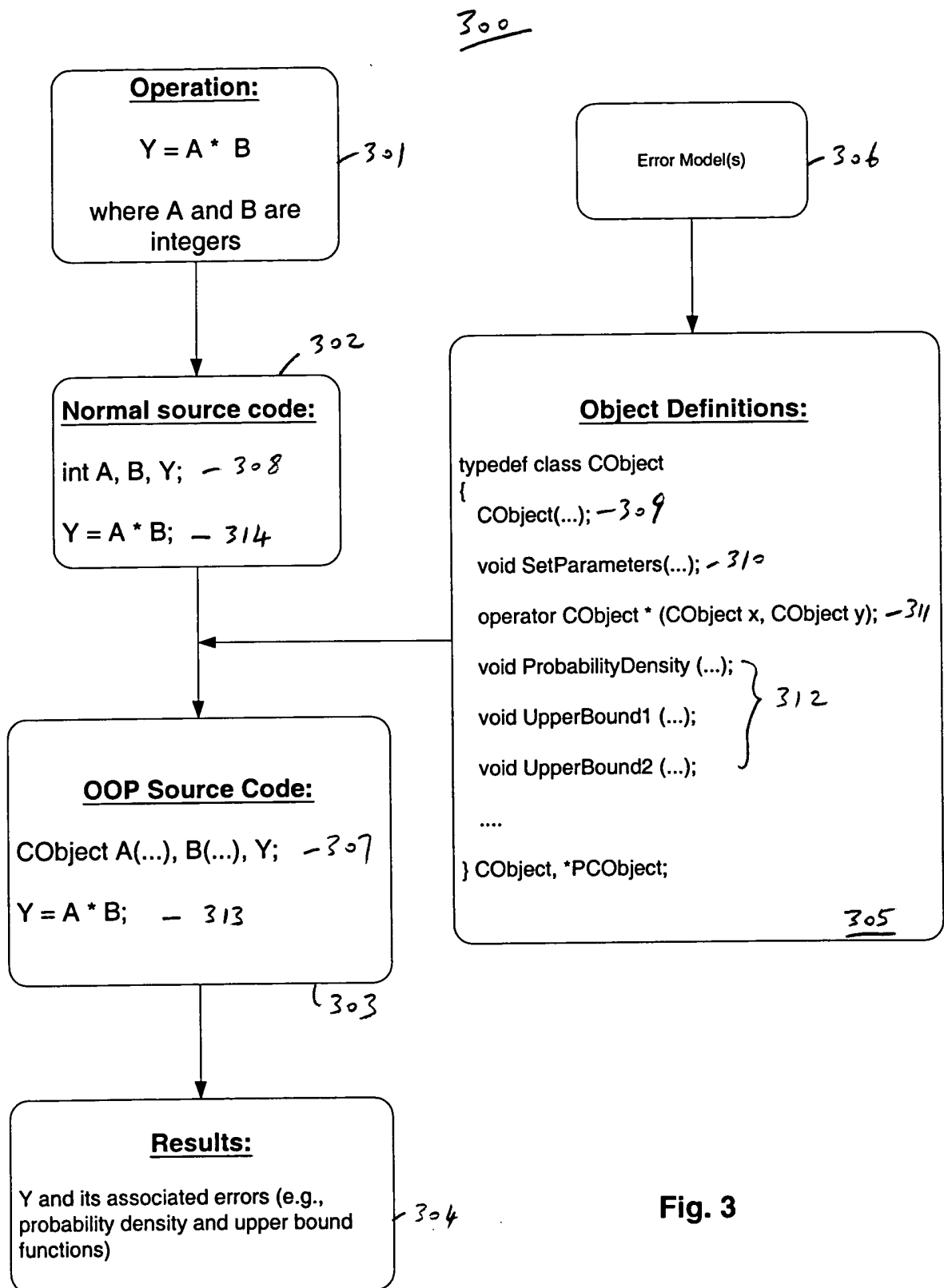


Fig. 3

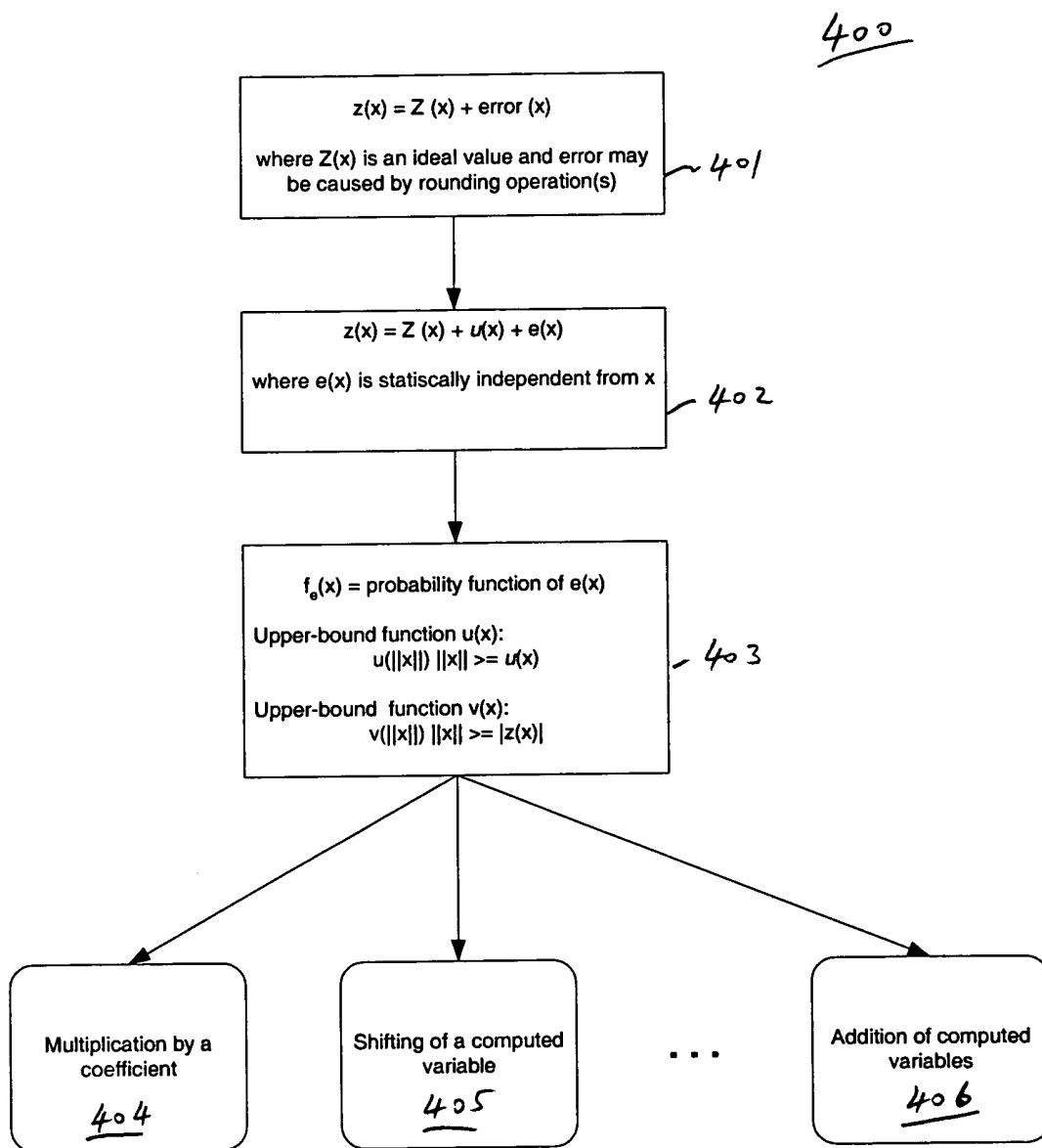


Fig. 4A

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Multiplication

$$z(x) = \hat{z}(x) + \mu(x) + \epsilon(x)$$
$$W = w + d$$

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$$Wz(x) = w\hat{z}(x) + w\mu(x) + d\hat{z}(x) + d\epsilon(x)$$

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Error Model:

$$f_e(t) = \frac{1}{W} f_e(Wt)$$
$$u(t) = |w| u(t) + |d| v(t)$$
$$v(t) = |w| v(t)$$

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Fig. 4B

Shifting of a computed variable

$$g(x) = Z(x) + \mu(x) + G(x)$$

right shifted by R bits

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$$2^{-R}g(x) = 2^{-R}Z(x) + 2^{-R}\mu(x) + 2^{-R}G(x)$$

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$$\lfloor 2^{-R}g(x) \rfloor = 2^{-R}Z(x) + 2^{-R}\mu(x) + 2^{-R}G(x) - d(x)$$

where $0 \leq d(x) < 1$

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Error Model:

$$f_e(t) = f_e(wt) * \text{uniform distribution } [-1, 0]$$

$$u(t) = 2^{-R} \mu(x)$$

$$v(t) = 2^{-R} v(t)$$

where "*" is a standard convolution operation

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Fig. 4C

Addition of Computed Variables

$$g_1(x) = Z_1(x) + \mu_1(x) + \epsilon_1(x)$$

$$g_2(x) = Z_2(x') + \mu_2(x') + \epsilon_2(x')$$

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$$g_1(x) + g_2(x) = Z_1(x) + Z_2(x') + \mu_1(x)$$

$$+ \mu_2(x') + \epsilon_1(x) + \epsilon_2(x')$$

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$$g(y) = Z(y) + \mu(y) + \epsilon(y)$$

$$\text{where } y = x \cup x'$$

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Error Model:

$$f_{\epsilon}(t) = f_{\epsilon_1}(t) * f_{\epsilon_2}(t)$$

$$u(t)t = \max_{p+q+r=t} \{u_1(p+q)(p+q) + u_2(q+r)(q+r)\}$$

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$$v(t)t = \max_{p+q+r=t} \{v_1(p+q)(p+q) + v_2(q+r)(q+r)\}$$

where $0 \leq p \leq \max \|a\|$, $0 \leq q \leq \max \|b\|$, and
 $0 \leq r \leq \max \|c\|$,

where $x = a \cup b$, $x' = b \cup c$

Fig. 4D

500

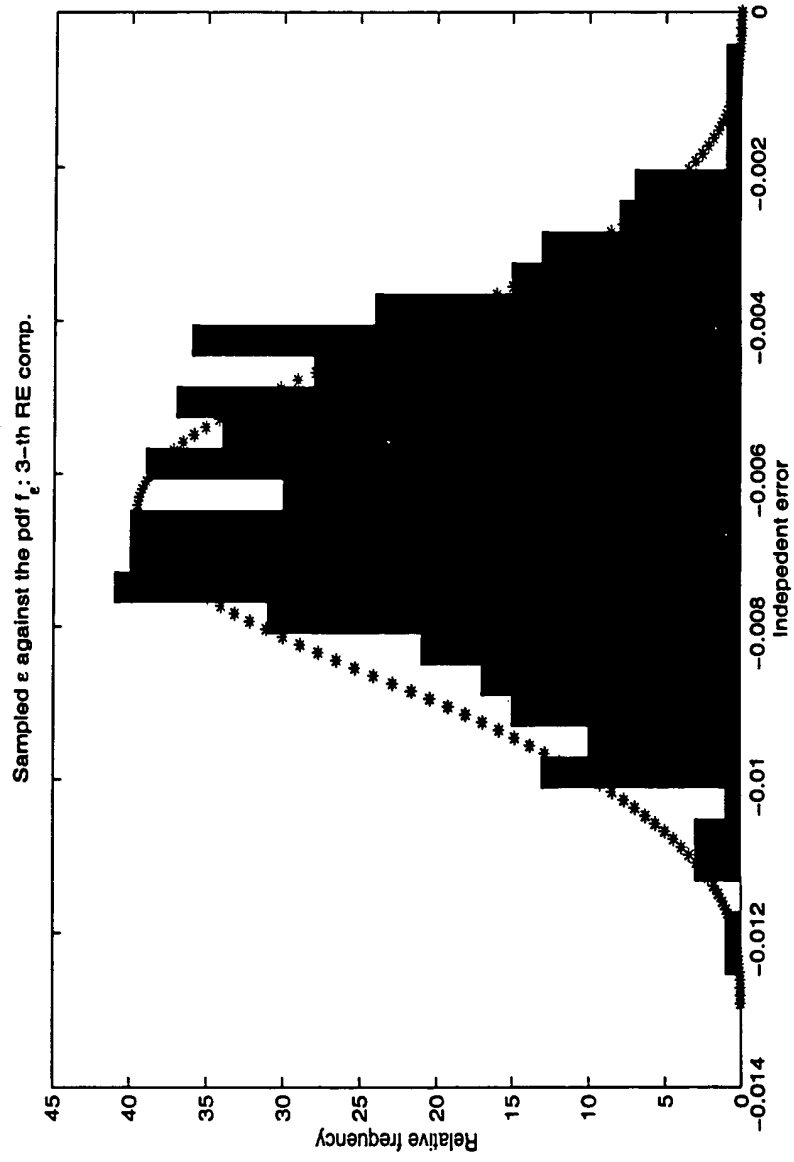


Fig. 5

600

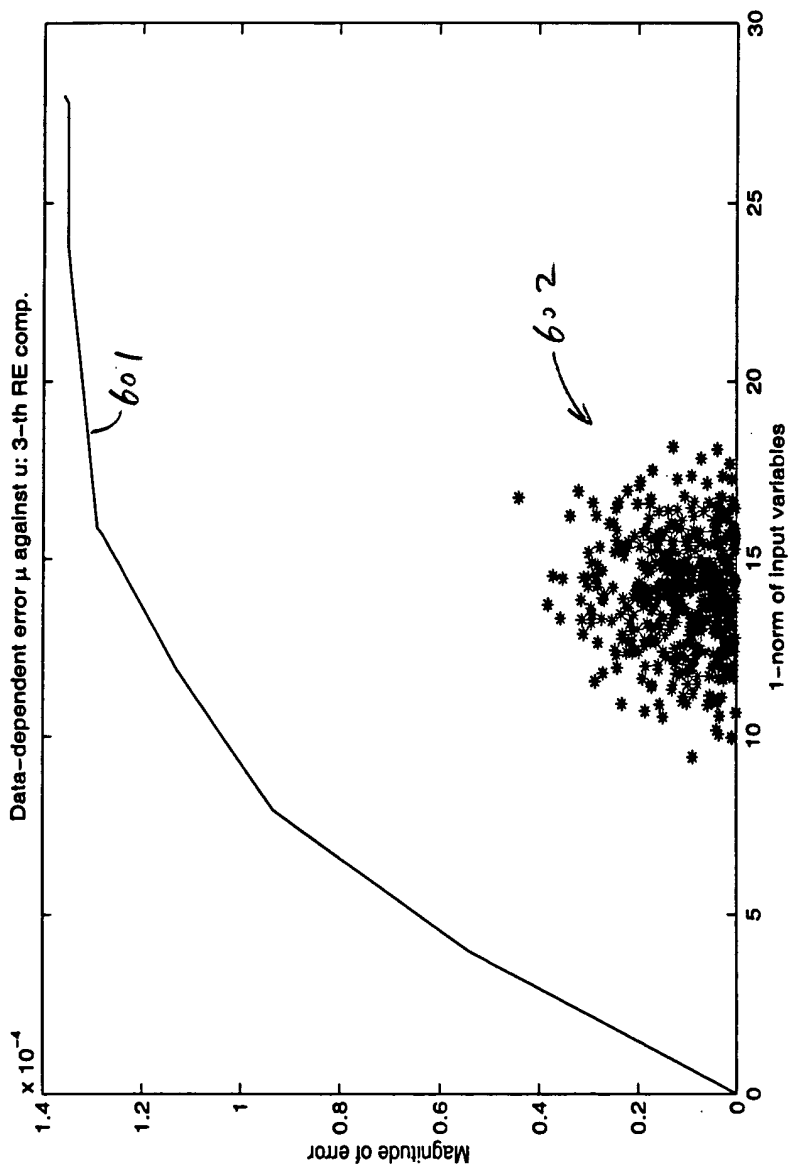


Fig. 6

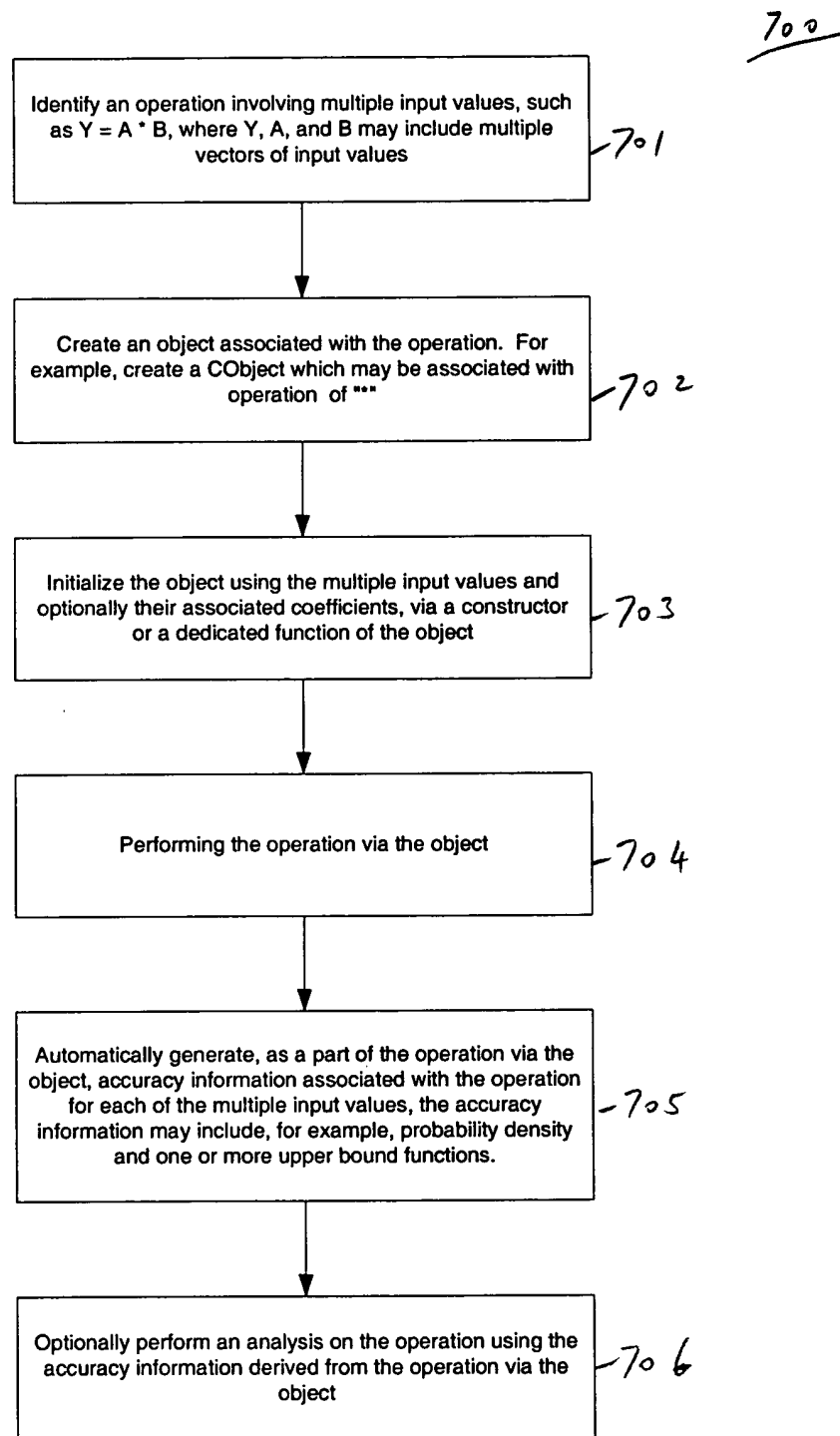


Fig. 7

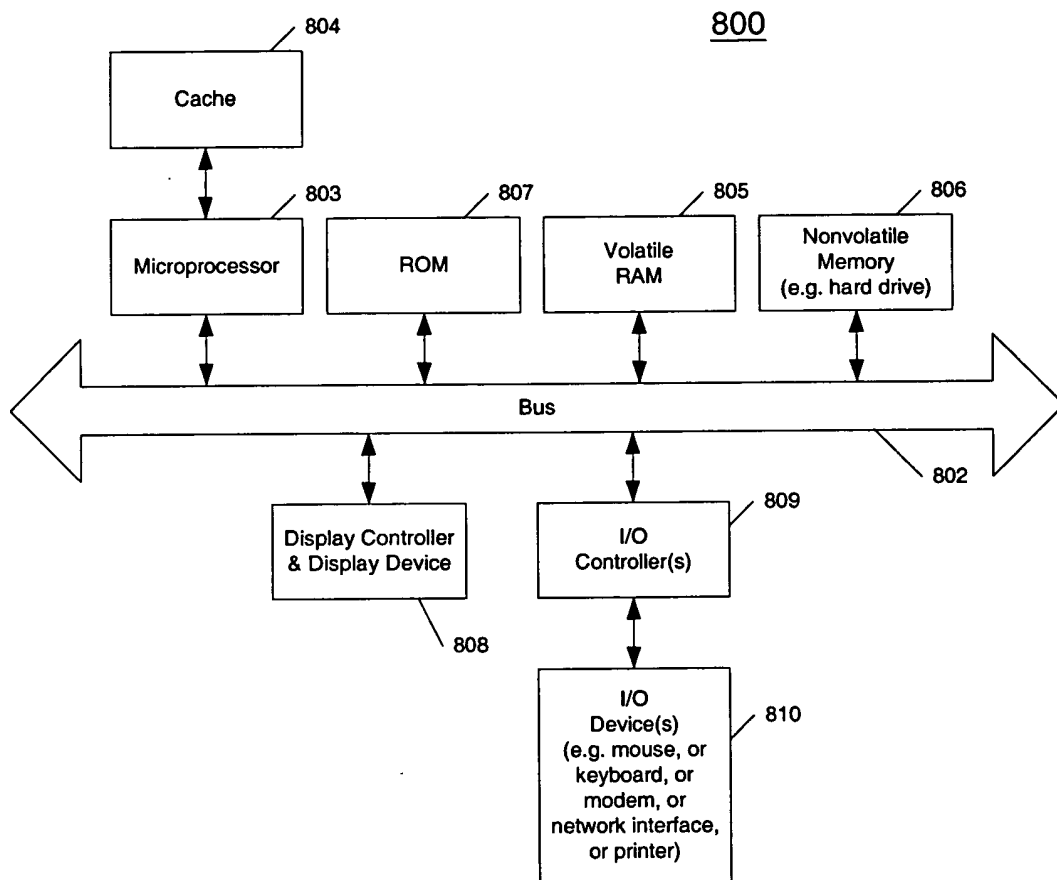


Fig. 8